

PHASE I: CONCEPT EXPLORATION

Step 2.0 Conduct HF/S Front-End Analysis

Objective: The objective of this step is to define the process for conducting the HF/S front-end analysis

Input: Inputs to this analysis include descriptions of legacy systems, and the PORD.

Output: The results of the analysis include HF/S concepts, and system deficiencies for the MNS.

2.1 Conduct Top-Down Function Analysis

2.1.1 Identify Legacy Systems

- Review the ORD and identify capabilities required in the new system
- Identify legacy systems where the functions are performed

2.1.2 Identify Functions

- for requirements identified in the ORD, identify functions performed by legacy systems
- prepare a functional flow block diagram depicting the sequence of top level functions for a mission scenario.

2.1.3 Identify and Analyze System Requirements

- identify requirements associated with functions and subfunctions. Requirements include:
 - knowledge/information requirements
 - what the system must know in order to complete the function;
 - requirements for generation and processing of knowledge specifically:
 - declarative knowledge of facts, capabilities, resources, mission requirement information.
 - conceptual knowledge wherein (a) relevant information is integrated, fused, correlated, prioritized, and synthesized into general principles; (b) meaning and context are provided to available information to enable the human to understand the situation and be able to formulate strategies for acting on the knowledge, and (c) uncertainty is reduced through maximized usage of all available information, including past history, trends, etc.
 - procedural knowledge understanding of processes, techniques, procedures, and task sequences.
 - characteristics of this knowledge and information, such as source, accuracy, timeliness, update rate, information handling requirements, etc.
 - performance requirements capabilities and criteria associated with the

- performance of functions and sub-functions
- cognitive requirements, including:
 - decisions to be made in the completion of a function, options, and decision rules;
 - problem solving and diagnostic requirements;
 - requirements for maintaining situation awareness.
- continue to identify requirements for function and sub-function performance in an iterative manner

2.1.4 Analyze and Decompose Functions

- analyze functions to successively greater levels of detail based on requirements identified for each function
- prepare functional flows at the successive sub-function levels

2.1.5 Develop a Database of Functions

- assemble descriptions of functions and sub-functions
- assemble requirements associated with functions
- enter functions and requirements into a database).

2.2 Identify High Driver Functions and Lessons Learned

2.2.1 Define the Legacy or Baseline Comparison System (BCS)

- review system functions from the mission/function analysis
- review prior decisions concerning equipment to be included, functions to be automated, and design approaches to be implemented.
- identify specific NDI, as applicable.
- identify product improvement, as applicable.
- for a new system development, identify the baseline system as the system or systems which currently enables the performance of the functions within the constraints

2.2.2 Define HF/S Measures of Effectiveness (HMOEs)

- Identify HMOE Objectives
 - identify HF/S concerns or personnel readiness requirements which are critical for system performance effectiveness, including specific performance constraints, known safety hazards, protection requirements, designated human capability levels, and human availability limitations
 - determine whether or not HF/S has been applied for the item
 - determine if the evaluation is addressing a new system, NDI, or a product improvement of a US or Allied system. If NDI, commercial off the shelf (COTS) or military off the shelf (MOTS). The evaluation should address a new, emerging system, NDI (either commercial off the shelf or military off the shelf), product improvement (US or Allies), or a baseline comparison system used in the

development of a new system.

- Identify the objectives of HMOE application: the objectives of HMOE application can include 1) assessment of the HF/S process, how effective was HF/S in meeting its goals; 2) assessment of HF/S products, adequacy of the design concepts and criteria, training program, and personnel utilization approach; and 3) assessment of the personnel readiness aspects of NDI, an existing system to be improved, or a baseline comparison system.
- Identify HMOE Evaluation Data Requirements
 - specify the data required in order to evaluate the effectiveness of HF/S application or to assess the personnel readiness of the system or item which had not had HF/S applied in its data requirements by each personnel readiness category:
 - personnel availability/utilization
 - personnel capability
 - personnel performance
 - personnel safety and health
 - Select Evaluation Methods and Conditions
 - identify evaluation methods which meet HMOE objectives and data requirements
 - analytic methods (where data are derived through analyses of the compliance of system design features or support provisions with standards or requirements)
 - empirical methods (application of experimental methods including simulations or controlled investigations of specific system features)
 - comparative measurement methods (measurement of some physical, functional or performance attribute of the system or system personnel, and comparison of these data to standards or criteria. Typical examples include environmental effects evaluations, application of design checklists, individual or team performance measurement, and workload assessment).
 - observation/walkthrough methods (observation of ongoing activities or controlled walkthrough of operational sequences by selected test participants or by the test conductor)
 - subjective methods (including procedures where data are obtained from subject matter experts or test participants by means of interviews, surveys or questionnaires)
 - identify conditions to be included or simulated in the evaluation
 - human characteristics such as mental capability, physical dimensions, level of stress, sensory and perceptual capabilities, and levels of skills;
 - features of the physical environment such as noise, vibration, lighting, temperature and humidity, terrain, clothing and weather;
 - own ship characteristics such as number, deployment, capabilities, and conditions of readiness
 - operational environment factors such as number of activities, workload, tempo of activities, sustained operations, constrained sequences, and number of crew members available
 - develop a sampling plan to ensure representativeness and fidelity of test conditions to actual or expected conditions. Sampling factors to be considered in ensuring representativeness and fidelity of test conditions to actual or expected conditions
 - clothing conditions

- anthropometrics
 - personnel aptitudes
 - personnel experience
 - environmental conditions
- Identify Evaluation Criteria
 - Identify system requirements criteria against which data are to be evaluated.
 - human performance criteria - standards of performance for functions allocated to humans
 - human productivity standards
 - personnel availability requirements
 - personnel capability limits
 - personnel safety and health requirements
 - system availability targets
 - system reliability criteria
 - Identify human factors engineering standards against which data are to be evaluated.
 - Identify safety/biomedical standards against which data are to be evaluated.
 - Identify HF/S requirements against which data are to be evaluated.
- Identify Evaluation Measures for baseline comparison system, NDI or product improvement evaluation for evaluation of system design and readiness
- Identify evaluation measures for evaluation of the adequacy of HF/S products
 - completeness
 - accuracy
 - feasibility
 - quality
 - timeliness
 - consistency
 - in compliance

2.2.3 Identify High Driver Functions

- Identify high drivers
 - collect data from appropriate subject matter experts (SMEs) on task criteria as they relate to each function and sub-function for the mission scenarios described in the mission analysis

2.2.4 Identify Lessons Learned

- Acquire lessons learned data
 - conduct documentation searches
 - conduct interviews
 - conduct observations
 - acquire measurements
- Analyze lessons learned data
 - identify training problems
 - identify personnel skill problems
 - identify operation problems

- identify environmental problems
- identify information management/quality problems
- identify human performance problems
- identify safety problems
- identify workload problems
- identify system effectiveness problems
- Validate lessons learned data
 - identify data needing validation
 - identify/resolve data inconsistencies
 - validate problems and causal factors
- Prioritize lessons learned data
 - prioritize in terms of mission impact
 - prioritize in terms of personnel performance and safety
- Use lessons learned to identify conditions, scenarios, design features, etc., which cause a function to be a high driver
- Integrate high driver/lessons learned data
 - identify problems which are HF/S problems
 - identify possible causes for problems
 - identify positive aspects of the BCS
 - identify positive aspects of BCS which should be retained
- Identify potential solutions to HF/S problems
 - identify design solutions
 - identify NDI solutions
 - identify product improvement solutions
 - identify manning solutions
 - identify selection/training solutions
 - identify policy/procedural change solutions
 - integrate problem solutions

2.2.5 Identify HF/S Issues and constraints

- Identify HF/S Issues - - for each function identified in the mission scenarios:
- Identify Constraints
 - Personnel Utilization Constraints Constraints on:
 - Personnel Performance Constraints
 - Personnel Safety & Health Constraints
 - Personnel Availability Constraints constraints on:
 - Personnel Capability Constraints

2.3 Analyze Missions and Generate Mission Scenarios

2.3.1 Describe the Mission and Mission Requirements

- Select missions - the missions to be assessed in the mission needs determination phase should comprise a representative sample of the missions for which the CG system is to be designed and the totality of missions should include most of the more important system requirements

2.3.2. Identify mission objectives

- Identify significant capabilities required to complete the mission
- Identify significant constraints that will delimit the performance of the mission
- Identify mission objectives

2.3.3 Identify Mission Phases

- pre-operational - planning and preparation
- transit
- conduct normal operations
- conduct contingency, degraded mode operations
- conduct resupply
- conduct maintenance
- conclude operations

2.3.4 Identify conditions under which functions are to be performed

- logistics conditions (length of supply lines, resupply frequency)
- conditions of readiness (systems not operational, extent of damage, etc.)
- environmental conditions (terrain, lighting and visibility, weather, temperature, etc.)
- operational conditions - requirements to achieve objectives
- operational conditions - sustained operations, clothing conditions, etc.

2.3.5 Identify Mission Events within Phases

2.3.6 Identify Event Schedules

2.3.7 Identify top level system functions by mission phase

2.3.8 Identify system requirements by function - specific capabilities which the system must have to enable performance of top level functions

2.3.9 Identify Criteria for Mission Success

2.3.10 Generate mission scenarios

- Define mission scenarios as the framework for identifying and analyzing system functions and human tasks, and conducting simulations of human performance and workload
- Develop scenarios in terms of:
 - objectives
 - mission requirements
 - missions
 - mission phases
 - functions
 - conditions
 - system requirements

2.3.11 Select mission scenarios

- those which emphasize HF/S - impacts on human performance and safety
- those which are representative of missions to be accomplished
- worst case scenarios
 - Identify criteria for prioritizing and selecting systems and mission scenarios. Criteria will include:
 - missions and systems that require high levels of workload for existing operations and/or maintenance;
 - missions and systems that place significant cognitive demands on personnel;
 - missions and existing systems that have exhibited human performance and safety problems that are amenable to HF/S technology;
 - missions and existing systems that exhibit cognitive problems and demands which are representative of the scope and complexity of cognitive demands that can be expected of advanced systems.

2.4 Conduct Mission/Function Analysis

2.4.1 Identify Functions

- for each scenario identified in step 2.3, identify relevant top level functions to be analyzed
- prepare a functional flow block diagram depicting the sequence of top level functions for a mission scenario.

2.4.2 Analyze and Decompose Functions

- analyze functions to successively greater levels of detail based on requirements identified for each function
- prepare functional flows at the successive subfunction levels

2.4.3 Identify and Analyze System Requirements

- identify requirements associated with functions and subfunctions. Requirements include:
 - knowledge/information requirements
 - what the system must know in order to complete the function;
 - requirements for generation and processing of knowledge specifically:
 - declarative knowledge of facts, capabilities, resources, mission requirement information.
 - conceptual knowledge wherein: (a) relevant information is integrated, fused, correlated, prioritized, and synthesized into general principles; (b) meaning and context are provided to available information to enable the human to understand the situation and be able to formulate strategies for acting on the knowledge, and (c) uncertainty is reduced through maximized usage of all available information, including past history, trends, etc.

- procedural knowledge understanding of processes, techniques, procedures, and task sequences.
- characteristics of this knowledge and information, such as source, accuracy, timeliness, update rate, information handling requirements, etc.
- performance requirements capabilities and criteria associated with the performance of functions and sub-functions
- cognitive requirements, including:
 - decisions to be made in the completion of a function, options, and decision rules;
 - problem solving and diagnostic requirements;
- requirements for maintaining situation awareness
- support requirements - support needed by the system to enable successful completion of each function
- interface requirements - situations where the system must interface with other systems in the completion of a function or subfunction.
- continue to identify requirements for function and subfunction performance in an iterative manner

2.5 Identify the Required Role of the Human (Allocation of Functions to Human or Machine Performance)

2.5.1 Assemble Mission Analysis Data

- access and consolidate data base data
- identify and list allocation high priority criteria/drivers
- review prior decisions concerning the role of human vs automation

2.5.2 Identify Prior Function Allocation Decisions

- identify prior decisions concerning system functions
 - functions which must be included
 - functions which may be required
- identify system operation functions to be automated
 - which functions will be automated
 - which functions are candidates for automation pending the review of technology state-of-the-art and requirements in step 6.0
- identify system maintenance functions to be automated
 - to what extent is BITE, ATE and automated troubleshooting to be employed
 - which functions are candidates for automation pending the review of technology state-of-the-art and requirements in step 6.0
 - Identify system operation functions to be performed manually
 - identify system maintenance functions to be performed manually
- maintenance functions which must be manual

- identify equipment to be incorporated into the system
 - specific equipment by function which is designated for the system
- identify mandated design decisions
 - extent to which the system will be composed of developed elements vs NDI vs product improvements
 - bases for these decisions
- identify prior decisions concerning the role of man in each system function

2.5.3 Integrate Functional Information and Identify Allocation Parameters

- consolidate functional information across mission segments
- identify and list allocation high priority criteria/drivers associated with each function allocation

2.5.4 Reverse Engineer the BCS Function Allocation in existing systems

- identify the allocation of functions in existing systems
- identify the rationale for this allocation decision
- identify constraints on increasing the level of automation in allocating the function in the emerging system

2.5.5 Allocate Functions --Determine Level of Automation

- determine if the function be fully automated
 - If it can, determine the roles of the human and automation
 - keep in mind that automating a function does not logically mean that the human does not have a role in the performance of the function, that he or she has effectively been designed out of the system for that specific function
 - in an automated function, the role of the human is less that of performer and more that of a manager, monitor, or backup performer or intervener.
 - if the decision is that the function in question cannot be performed totally by automation, continue the decision process:
- Determine if the function can be automated with human supervision
 - if yes, the roles of the human and automation are identified.
 - if no, continue the decision process:
- Determine if the function can be performed by human/automation interaction
 - if so, the roles of humans and automation are identified.
 - in this allocation each element has some responsibility for some facet of function performance, and the allocation of these functions may vary in the operational setting due to workload, safety, or uncertainty considerations (dynamic function allocation).
 - if this allocation is not viable, continue the decision process:
 - Determine if the function can be performed by humans with machine aiding.

2.5.6 Identify Roles of Humans and Automation

- In dealing with complex systems the issue is not so much defining the allocation of system functions or subfunctions to human or machine performance as establishing the role of the human in the system.
- In highly automated systems where both human and machine are equally competent to perform individual functions, the design issue is to determine the role of the human vs automation in the performance of each function.
- The emphasis on the role of human in the system acknowledges the fact that the human has some role in every system function. In some cases that role may encompass actual performance of the function, while in others it may involve monitoring machine performance.
- It is also important to realize that an assigned role for human performance may change with changes in operational conditions. Thus a function optimally performed by a human under certain conditions of workload, time constraints, or task priority, may be more optimally automated under other conditions.
- The specific roles to be considered for human and machine performance as a result of the allocation of function decision process are depicted in the associated [Table](#).
- The purpose of establishing the roles of humans and automation for the allocation of function decision is to define the level of involvement of the human in the information processing, decision making, and execution activities associated with the conduct of system functions.

2.6 Identify Alternative Human Performance Concepts

2.6.1 Identify Workload Reduction Requirements and Potential

- Identify workload reduction requirements from high driver functions and conditions
- Identify Workload Reduction Potential through Function Automation
 - Identify functions and task sequences for which automation is suggested based on the function allocations
 - Identify task sequences that are amenable to automation
 - Identify the potential for function automation from subject matter experts - from the Fleet and tech codes
 - Summarize relevant roles of machines in automated functions
 - Summarize the roles of the human in automated functions
- Identify Workload Reduction Potential through Function Consolidation
 - Identify functions and task sequences for which consolidation is suggested based on the function allocations
 - Identify task sequences that are amenable to consolidation
 - Identify task network simulation results indicating the potential for function consolidation
 - Identify the potential for function consolidation from subject matter experts - from the Fleet and tech codes
 - Identify techniques of achieving function consolidation
- Identify Workload Reduction Potential through Function Elimination
 - Identify functions and task sequences for which function elimination is suggested based on the function allocations

- Identify task sequences that are amenable to function elimination
- Identify task network simulation results indicating the potential for function elimination
- Identify the potential for function elimination from subject matter experts - from the Fleet and tech codes
- Identify techniques of achieving function elimination
- Identify Workload Reduction Potential through Function Simplification
 - Identify functions and task sequences for which function simplification is suggested based on the function allocations
 - Identify task sequences that are amenable to function simplification
 - Identify task network simulation results indicating the potential for function simplification
 - Identify the potential for function/task simplification from subject matter experts - from the Fleet and tech codes
 - Identify techniques of achieving function simplification

2.6.2 Identify Technology Options to Support Workload Reduction

- Identify HF/S Requirements by System Function
 - review alternative system operational and support concepts
 - identify functions associated with concepts
 - review function requirements
 - review projected operator/maintainer tasks/sequences by function
 - identify HF/S requirements by function
- Survey the State-of-the-Art in HF/S Technology
- Identify technology requirements for function automation
- Identify technology requirements for function consolidation
- Identify technology requirements for function elimination
- Identify technology requirements for function simplification
- Rank Order Technology Alternative
- Assess Technology Availability and Applicability
- Describe Needs for Advanced Technology

2.6.3 Identify/Assess Legacy Systems from Steps 2.1.1 and 2.2.1

2.6.4 Identify/Assess NDI

- Identify HF/S Inputs to NDI Concepts and Issues
 - Determine the extent to which the NDI must meet users' needs and functions in users' environment.
 - Determine HF/S issues in NDI flexibility in operational requirements.
 - Tailor the acquisition process for NDI
 - Provide inputs to Effectiveness Trade-offs.
 - Assess NDI reliability vis-a-vis the total system reliability.
 - Provide inputs to evaluate producers' processes, production methods, and production control procedures.
 - Provide inputs to the determination of Life Cycle Cost - determine how to identify which NDI approach:

- Provides HF/S inputs to the determination of ILS requirements
 - Identifies Safety and Environment Issues.
 - Determines Workload and Personnel Issues.
 - Determines Training Issues.
 - Determines Human Performance Issues
 - Determines HF/S Survivability Issues
 - Determines HF/S Test and Evaluation Issues
 - Determines HF/S issues for NDI Modification.
- Identify HF/S Inputs to market surveys
 - Provide HF/S Inputs to Market Surveillance
 - Provide HF/S Inputs to Market Investigation Plan
 - Provide HF/S Inputs to Market Investigations.
- Identify human performance requirements for NDI
- Identify HF/S supportability requirements for NDI
- Identify impacts of HF/S on life cycle costs
- Identify safety and health requirements for NDI
- Identify manpower & personnel requirements for NDI
- Identify training requirements for NDI
- Identify survivability requirements for NDI
- Identify test and evaluation requirements for NDI
- Identify ILS requirements for NDI
- Provide HF/S input to the Procurement Documents
- Provide HF/S input to the Commercial Item Description

2.6.5 Define and Assess Workload Reduction Strategies

- Develop alternate design concepts
- Describe the distinguishing features of design concepts
- Conduct Tradeoffs to Select Feasible Concepts
 - Identify criteria to be used in making concept tradeoffs - effects on system performance/readiness, and impacts on personnel availability, utilization, capability, performance, productivity, and safety.
 - Assign importance weights to criteria
 - Conduct tradeoffs
 - Select feasible workload reduction strategies

2.6.6 Develop Alternate Concepts for Control Space Organization

- Sort human roles by control space
- Develop alternate concepts for control space organization
- Develop tradeoff criteria to assess alternate control space organization concepts
- Conduct tradeoffs and select feasible control space organization concepts
- Identify teams within control spaces

2.6.7 Develop Position Descriptions for Alternate Control Space Concepts

- Identify positions in terms of a control space organization concept
- Identify human-machine interface requirements for each position

- Integrate human interface requirements to describe each position

2.6.8 Identify Human-Automation Interaction Requirements to Support Workload Reduction Concepts

- Review roles of humans and automation
- Identify requirements for human-automation collaboration:
 - requirements to ensure an understanding on the part of the human as to what is going on in the automated system
 - requirements to ensure that the human understands what he or she needs to do next
 - requirements to ensure that the human understands what response to expect of the system
 - requirements to ensure that the human maintains situation awareness and operational perspective.
- Identify requirements for human-machine interfaces
 - requirements to ensure that human-computer interfaces have been designed in accordance with user cognitive, perceptual, and short-term memory capabilities and limitations
 - requirements to ensure that software command modes are transparent to the user
 - requirements to ensure that displays and display formats are standardized and are easily read and interpreted
 - requirements to ensure that the user understands the capabilities of the system and the procedures required to exercise these capabilities
 - requirements to ensure that procedures are logically consistent
 - requirements to ensure that user documentation is clear, easily accessed, and readable
 - requirements to ensure that on-line help is available and responsive
 - requirements to ensure that the user is only provided with that information needed when it is needed
 - requirements to ensure that the user understands how to navigate through a program and retrieve needed information.
 - requirements to ensure minimum error potential - likelihood of error occurrence
 - requirements to enhance the probability that, having occurred, an error can be corrected
 - requirements to enhance user productivity - amount completed per unit time

2.7 Assess Requirements and Concepts

2.7.1 Develop HF/S Measures of Effectiveness

2.7.2 Evaluate Workload Reduction Approaches for Systems/Subsystems

2.7.3 Evaluate Manning Requirements Approaches for all CG resources

- Evaluate the affordability of manning approaches
- Evaluate risks associated with manning approaches

2.7.4 Assess Design Requirements to Support reduced workload

- Assess the design of functional interfaces
 - roles of humans versus automation in system operation, control, maintenance and management
 - human functions and tasks
 - roles of system personnel in automated processes (e.g., monitoring, management, supervision, intervention, etc.)
- Assess the design of information interfaces
 - availability, currency, and usability of information required by personnel from the computer
 - availability, currency, and usability of information required by the computer from personnel
 - availability and usability of protocols and dialogues for information access, entry, update, verification, dissemination and storage
- Assess the design of environmental interfaces
 - adequacy of the physical environment (light, noise, temperature, etc.)
- Assess the design of operational interfaces
 - accessibility, adequacy, and usability of procedures
 - adequacy of workloads
 - adequacy of personnel manning levels
 - adequacy of system response time
- Assess the design of organizational interfaces
 - adequacy and responsiveness of management organization
 - adequacy of job organization - job design
 - adequacy of data organization
 - adequacy of command modes
- Assess the design of cooperational interfaces
 - adequacy of person-person interaction and communication
 - adequacy of team performance
 - adequacy of provisions for collaboration
- Assess the design of cognitive interfaces
 - availability and usability of decision aiding
 - availability and usability of on-line help
 - availability and usability of intelligent tutoring
 - availability and usability of decision rules
 - availability and explicitness of cognitive maps
 - adequacy of information integration
 - adequacy of situational awareness provisions
 - availability and adequacy of provisions to counter effects of psychological stress
 - adequacy of personnel skills
 - adequacy and usability of human computer interfaces
- Assess the design of physical interfaces
 - adequacy and usability of input/output devices (controls, displays, labels, markings, keyboards)
 - adequacy of maintainability design features
 - adequacy of operability design features
 - adequacy of safety design features

- adequacy of health hazard elimination design features
- adequacy of survivability design features
- adequacy of supportability design features

2.8 Develop Task Networks and Analyze Task Requirements

2.8.1 Identify mission scenarios to be included in the task analysis

- identify missions to be analyzed
- identify and describe mission scenarios

2.8.2 Compile Functions and Roles

- for each scenario, compile required functions
- for each function, identify applicable roles of humans and automation

2.8.3 Identify Verbs for Roles

- identify verbs associated with human roles

2.8.4 Identify Tasks

- Define tasks for each function by combining the verbs for functions with nouns associated with the function
- Identify complete task sequences for each function

2.8.5 Assign tasks to crew position(s)

- Identify relevant positions
- Determine all positions involved in the task
- Assign tasks to positions

2.8.6 Identify criteria for successful task performance

- Identify the system state at the conclusion of the task
- Identify the impact of the task on mission success
- Identify the impact of the task on human performance capability and safety

2.8.7 Identify knowledge and information required for task performance

- identify the information required for the system to perform the task
- identify the characteristics of identified information (availability constraints, update rates, accuracy and currency requirements).
- identify information required by operator/maintainer, including cues for task initiation
- identify the information available to operator/maintainer
- identify feedback informing the human of the adequacy of actions taken
- identify knowledge of the external world needed for the task
- identify specific knowledge concerning the CG resources needed to enable and

support performance of the task

- identify specific knowledge concerning the crew readiness needed to enable and support performance of the task

2.8.8 Identify physical capabilities required for task performance, including performance time and accuracy, strength and endurance, actions taken, body movements, operational limits of personnel, and reach and vision envelopes.

2.8.9 Identify cognitive capabilities required for task performance

- identify decision requirements
- identify diagnostic requirements
- identify problem solving requirements
- identify short-term memory requirements
- identify information integration requirements
- identify requirements for maintaining situation awareness
- identify requirements for interacting with the automated system

2.8.10 Identify communications/collaboration required for task performance

- identify personal interactions required for task performance
- identify communication requirements
- identify data link requirements

2.8.11 Identify task characteristics

- identify task frequency/tempo
- identify task duration
- identify constraints on task performance location

2.9 Conduct HF/S Workload/Manning/Human Performance Simulation

2.9.1 Select Alternative System Concepts for Simulation

- elect system concept(s) that will likely reveal significant performance differences and that are derived from the mission/function analysis
- define alternative system concepts in terms of function allocations/role of human
- describe alternative system concepts

2.9.2 Set up Simulation Model

- select missions scenarios and functions
- identify the function allocation(s) to be analyzed or investigated
- identify/input tasks to be performed for each function
- identify/input automated operations for each function
- identify/input personnel qualified for each task (primary and secondary)
- identify error rate assumptions for each task
- identify/input predecessor tasks and task dependencies (develop the task network)

- estimate/input minimum, median and maximum task completion times
- identify simulation (or process) variables of interest (e.g., number of targets radar contacts)
- develop subroutines
- debug subroutines

2.9.3 Conduct Simulation

2.9.4 Analyze Data

- identify tasks that are repeated frequently or that require a considerable amount of an operators time
- identify/analyze tasks that could be automated, reallocated, eliminated or simplified
- update the task network and data to model alternative solutions

2.10 Develop and Validate HF/S Requirements

2.10.1 Define a manning budget by specific system and subsystems

- Estimate system Officer, Enlisted, and civilian billet requirements for each option based on analysis using the baseline workload model as modified by other reference system data applicable to each option and applying reasonable manning and optimization assumptions.
- Review the high driver functions, and systems which are high users of manpower/workload.
- Complete a preliminary identification of design and equipment modifications and technology applications needed to reduce workloads and manning for the high drivers, and to define a preliminary manning budget for subsystems. The output of this step will be the preliminary manning budgets by subsystem, and a preliminary manning model for the total system, taking into account the proposed approaches to reduce workload.
- Define the total system manning budget
- Summarize manning requirements for total system by mission scenario
- Develop a baseline workload model to assess the impact of system design approaches.
- Define requirements for human-machine interfaces to support total system reduced workload
- Define requirements for training programs to support total system reduced workload
- Define requirements for implementing total system reduced workload.
- Identify acquisition and life cycle costs associated with total manning concepts.
- Develop the System Manning Estimation Model

2.10.2 Develop Human Performance Requirements by System

- Review human performance high drivers, issues and lessons learned
- Define human performance issues for each alternative system concept and for each function allocation and role of human approach
- Define human performance requirements and constraints for each alternative system

concept and for each function allocation and role of human approach

2.10.3 Develop Safety Requirements by System

- Review safety high drivers, issues and lessons learned
- Define safety issues for each alternative system concept and for each function allocation and role of human approach
- Define safety requirements and constraints for each alternative system concept and for each function allocation and role of human approach

2.10.4 Integrate HF/S Requirements

- Identify incompatibilities and inconsistencies among requirements
- Resolve incompatibilities and inconsistencies among requirements
- Integrate HF/S requirements
- Provide HF/S inputs to the Mission Needs Statement (MNS)
 - Description The purpose of the MNS is to describe specific functional capabilities required to perform Coast Guard missions, and to identify deficiencies which cannot be met with non-material solutions. The MNS is normally derived from a quantified, well-documented, objective mission analysis.
 - HF/S Contribution sections of the MNS which should receive inputs from the HF/S program include the following:
 - *Planned Capability* functional capability required. HF/S should identify implications of the functional capability requirements for human performance and safety;
 - Proposed Alternatives - alternate function allocation concepts, and implications of system level alternatives for the roles of humans;
 - Risks - potential risks including cost, schedule and performance. HF/S should identify human performance, manning, personnel, and safety deficiencies and issues for existing systems, and projected risks for human performance and safety for the alternatives.
 - Acquisition Strategy Objectives - implications of the selected Acquisition Strategy for human performance and safety.
- Provide HF/S inputs to operational requirements (ORD and PORD)
 - Description The purpose of the ORD/PORD is to provide a bridge between operational requirements from the MNS and detailed technical requirements that will be found in the specification governing the development of the system. The Preliminary Operational Requirements Document (PORD) identifies requirements in terms of minimum thresholds and operationally effective goals needed to develop and evaluate alternative design concepts.
 - HF/S Contribution sections of the PORD/ORD which should receive inputs from the HF/S program include the following:
 - Section II, Philosophy, C. Reliability *include concerns for human reliability and human error problems identified in existing systems;*
 - Section II, Philosophy, E. Maintainability - *identify maintenance problems in existing systems, and HF/S considerations for maintenance of the emerging system;*
 - Section II, Philosophy, G. Personnel, Safety and Environmental

Considerations

- Current personnel necessary to safely operate, maintain and support similar existing systems;
- staffing goals and requirements;
- physical (habitability) requirements for personnel (including working, eating, living and sleeping areas and mixed gender considerations);
- unique personnel or safety requirements .
- Section II, Philosophy, H. Training *identify HF/S requirements that will impact training.*
- Section III Mission Requirements, D. Critical Operational Issues *identify HF/S issues for the emerging system based on deficiencies in existing systems, and human performance and safety requirements and constraints in the emerging system. COIs include operational effectiveness and operational suitability issues that must be addressed during OT&E to evaluate/assess the system's capability to safely perform its mission.*
- Section IV Critical Technical Parameters, D. Communications/Data Processing *address requirements for human communications, team performance, and usability of computer systems.*
- Section V, Tradeoffs - *include HF/S tradeoffs, such as role of the human, human interaction with automation, reliance on on-board training, etc.*
- Section VI, Appendices, Cutters and Boats *appendix on human factors.*
- Provide HF/S inputs to the Phase 1 Proposal (P1P)
 - Description The purpose of the P1P is to serve as the Acquisition Plan for the Concept Exploration Phase. It will include concepts/alternatives to be explored, a cost estimate for the Concept Exploration Phase, and an acquisition strategy for the Concept Exploration Phase.
 - HF/S Contribution sections of the P1P which should receive inputs from the HF/S program include the listing of concepts/alternatives, which should include concepts for function reallocation, and concepts for human-machine interfaces.
- Provide HF/S inputs to the Acquisition Plan (AP)
 - Description The purpose of the AP is to establish a disciplined, formally
 - documented planning procedure for Coast Guard major acquisitions. The AP shall briefly summarize the key points and the status of the following documents: LCCE, ORD, RMP, Contractor Performance Measurement, TEMP, ILSP, LRIP, and CBA.
 - HF/S Contribution - review of the documents addressed in the AP.

2.10.5 Validate HF/S Requirements HF/S requirements will be validated by means of a review conducted with operational Coast Guard personnel who will judge the validity and appropriateness of the requirements.